Some Earth bacteria survive and grow at extremely low pressure, may aid Mars research

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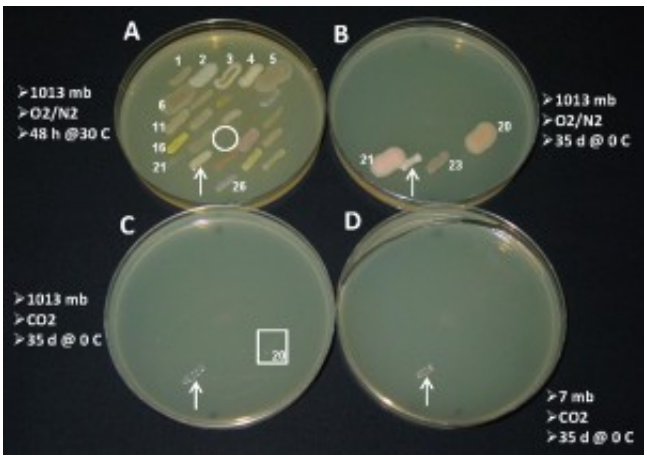


Twenty-six bacteria typically recovered from spacecraft were examined by UF researchers to see if they could grow under low pressure, temperature and oxygen conditions like those found on Mars. Plate A shows the control group grown under standard Earth pressure (1013 millibars) and oxygen and at 86 degrees Fahrenheit. Plate B shows the bacteria that can survive when temperature is dropped to freezing. Plate C shows the bacteria that survived with freezing temperature and no oxygen. Plate D shows bacterial growth at pressure as low as that on Mars (7 millibars), no oxygen and freezing temperature. Only one bacterium, Serratia liquefaciens, survived the harsh conditions. Arrows indicate locations of Serratia liquefaciens. Credit: Schuerger et al.

(Phys.org)—University of Florida researchers have discovered for the first time that some Earth bacteria can live under the same low pressure

conditions found on Mars.

The results could help scientists protect Mars from contamination by Earth bacteria during spacecraft missions, as well as aid in the search for life on that planet.

The researchers reveal their findings in two studies, one published in late December in the journal Proceedings of the National Academy of Sciences and one published online today by the journal *Astrobiology*.

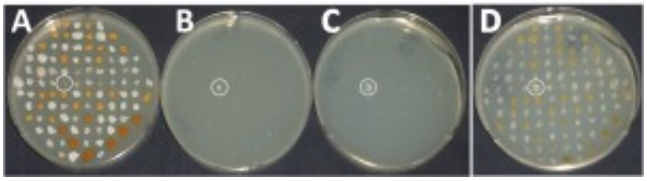
"As we send spacecraft to Mars, we want to have confidence that we're not going to contaminate the landing sites," said Andrew Schuerger, a co-author of the studies and a research assistant professor in UF's plant pathology department.

Understanding the minimum set of conditions required for bacterial growth and replication on the Martian surface is key, said Schuerger, a member of UF's Institute of Food and Agricultural Sciences.

Wayne Nicholson, also a co-author of the studies and a professor in the UF/IFAS microbiology and cell science department, said he and Schuerger are interested in investigating if Earth bacteria can grow in the Martian environment.

"We want to know, once you transport an Earth bacterium to Mars, can it survive, let alone grow?" Nicholson said.

Schuerger and Nicholson found bacteria in the genera Serratia and Carnobacterium that could survive under the Mars conditions of low oxygen, freezing temperatures and 7 millibars of atmospheric pressure. In comparison, pressure at sea level on Earth is about 1,013 millibars.



Growth of Carnobacterium isolates. Plate A shows growth with freezing temperatures and Earth pressure and atmosphere. Plate B shows growth with freezing temperatures, low oxygen and Earth pressure. Plate C shows growth with freezing temperatures, low pressure and low oxygen. Plate D shows the same plate as in C, but after one additional day of incubation on the laboratory bench (i.e., at room temperature, Earth atmospheric composition and pressure). Credit: Nicholson et al.

With these discoveries, new experiments to test whether these hardy bacteria can survive the more than 17 harsh factors on the surface of Mars—including high salt levels, intense radiation and severely dry conditions—can now be conducted.

By identifying which harsh conditions the bacteria can survive, scientists can more readily identify locations on Mars with these conditions because they may be at the most risk for contamination.

And although these areas may be at most risk, their characteristics may also make them conducive for possible Martian microbial life, Nicholson said.

"It's a conundrum," he said. "Because if you're looking for life, you want to go to the places that are most likely to harbor life, and of course those are the very same places that are most sensitive to being contaminated by Earth organisms."

Preventing the escape of Earth microbes is important for several reasons,

the researchers said. One of them is to minimize the probability of a "false-positive," i.e., detecting Earth microbes while searching for Mars microbes.

All spacecraft and equipment are carefully cleaned before launch, and the harsh conditions of interplanetary space are likely to reduce, but not eliminate, many viable microorganisms prior to landing.

One of the reasons scientists are interested in finding bacteria on Mars is to address the theory that planets are not biologically isolated. If bacteria are found on Mars, they can be genetically tested to see if they are related to Earth bacteria. If they aren't, it could mean life started in two different places. If they are related, it could mean life began on one planet and was transferred to another, possibly as the result of an asteroid impact.

While both studies examined the abilities of bacteria to grow at low pressures, each examined different bacteria.

For the *PNAS* study, researchers looked at growth of bacteria recovered from boring 40 to 70 feet into Siberian permafrost, while the Astrobiology study examined bacteria commonly found on spacecraft.

Some 10,000 bacteria were screened in the permafrost study for their ability to survive under low pressure, temperature and oxygen conditions. Of this number, six—all members of genus Carnobacterium—survived and grew.

In the Astrobiology study, 26 bacteria typically recovered from spacecraft were examined to see if they could grow under low pressure, temperature and oxygen conditions. Only one bacterium, Serratia liquefaciens, survived the harsh conditions.

Carnobacteria represent microorganisms that live in cold environments, such as deep within permafrost, whereas Serratia liquefaciens is a common bacterium found in more temperate environments like human skin, fish, plants and soil.

Schuerger called the discoveries "exciting" but cautioned that it does not mean bacteria can grow on current-day Mars.

"It opens up much more complex research that was not previously available to us because we didn't know if anything could grow at 7 millibars," he said. "But there are still numerous biocidal and inhibitory factors on the surface of Mars that are likely to inhibit the growth of terrestrial microorganisms at the surface."

More information: The *PNAS* study is available at www.pnas.org/content/early/201 … 793110.full.pdf+html and the *Astrobiology* study is at online.liebertpub.com/doi/pdfp … 0.1089/ast.2011.0811

Provided by University of Florida

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